COMPACT MAGNETIC INDUCTION SWITCH

CROSS-REFERENCES TO RELATED APPLICATIONS

[0001] This application is a continuation of U.S. Patent Application Number 10/246,598 filed September 18, 2002, the entire contents of which are incorporated herein by this reference, and which claims priority to JAPAN 2001-343194 filed November 8, 2001.

BACKGROUND OF THE INVENTION

Field of the Invention

[0002] The present invention relates to a non-contact type compact magnetic induction switch capable of being switched ON and OFF by a slight operating force.

Description of the Related Art

[0003] As for a conventional compact switch, there are available a mechanical contact type switch and a proximity switch utilizing an oscillator. However, the contact type switch has its limit in making the operating force small, and further miniaturization thereof is difficult. While, the proximity switch is complicated in its structure, and has its limit in reducing the cost.

[0004] Further, a Hall effect type position sensor which combines a permanent magnet and a Hall element is used as position detection means for various types of equipment. This position sensor attaches the permanent magnet to a detected body whose position is desired to be detected so that magnetic field generating portions are constituted and, at the same time, a magnetic detection portion comprising the Hall element is constituted so as to be

relatively displaced against these magnetic field generating portions. When the magnetic field generating portions come close to the magnetic field detection portion, the Hall element of the magnetic field detection portion detects the magnetic field from the magnetic generating portions by means of the Hall effect and outputs an electrical signal, thereby detecting the position of the detected body. The Hall effect type position sensor which constitutes such a Hall element as the magnetic field detection portion does not have a mechanical contact such as a micro switch and the like, and has the advantages of being highly reliable in operating in non-contact on the detected body and, hence, is adopted in a wide range of applications.

[0005] Since the object of the sensor is to detect the position, though a measure for improving position detection accuracy is taken, using the sensor as a compact switch is not taken into consideration. Therefore, improving the function of the sensor as the compact switch is not taken into account.

SUMMARY OF THE INVENTION

[0006] The object of the present invention is to provide an ultra compact magnetic induction switch, whose operating force is made as small as possible and whose size is made as compact as possible.

[0007] Additionally, the above described object is realized by the compact magnetic induction switch comprising: a switch case; a movable member provided on an opening of the switch case and being reciprocally movable; an elastic body which is installed inside the switch case and urges an end portion of the movable member so as to be protruded outside of the switch case; a magnet fixed to the movable member; and a Hall IC for detecting change of magnetic field caused by movement of the movable member with its operating point,

wherein if the magnet field applied to the operating point of the Hall IC becomes above or below a threshold by movement of the movable member, output signal of the Hall IC switches on/off.

[0008] In the compact magnetic induction switch of the present invention, the positioning portion which positions the Hall IC at a predetermined position may be provided inside the switch case.

[0009] Alternatively, a guide portion which guides the movable member may be provided inside the switch case. A lid member which is fitted into the bottom of the switch case may be provided and an opening which derives the lead wire of the Hall IC or an opening which injects a filling agent may be provided on the lid member.

BRIEF DESCRIPTION OF THE DRAWINGS

[0010] Fig. 1 is a plan view of one embodiment of a switch of the present invention;

[0011] Fig. 2 is a front sectional view of the embodiment;

[0012] Fig. 3 is a side sectional view of the embodiment;

[0013] Fig. 4 is a bottom view of the embodiment;

[0014] Fig. 5 is a front sectional view of a switch case in the embodiment;

[0015] Fig. 6 is a side sectional view of the switch case;

[0016] Fig. 7 is a side view of the switch case;

[0017] Fig. 8 is a bottom view of the switch case;

[0018] Fig. 9 shows the operation principle of the inventive switch;

[0019] Fig. 10 is a plan view of a mounting bracket to be used to mount the switch of the invention;

[0020] Fig. 11 is a side view of the mounting bracket;

[0021] Fig. 12 is a front view of the mounting bracket;

[0022] Fig. 13 is a plane view of a lid member to be used to seal the switch of the invention;

[0023] Fig. 14 is a front sectional view of the lid member; and

[0024] Fig. 15 is a side sectional view of the lid member.

DESCRIPTION OF THE PREFERRED EMBODIMENT

[0025] One embodiment of a compact magnetic induction switch of the present invention is shown in FIGS. 1 to 8. In the drawings, reference numeral 1 denotes a switch case, reference numeral 2 a movable member, reference numeral 3 a spring coil, reference numeral 4 a Hall IC, reference numeral 5 an output lead wire thereof and reference numeral 6 a permanent magnet, for example, such as a rare earth magnet.

[0026] The switch case 1, as shown in FIGS. 2 to 8, has a chamber la, in the interior of which are stored the movable member 2, the spring 3 and the Hall IC 4. In the chamber 1a, there are a positioning portion 1b and a guide portion 1c integrally provided with the switch case, and the positioning portion 1b comprises three pieces of positioning portions 1b1 to 1b3. The guide portion 1c has rail-shaped guide members 1c1, 1c2 which protrude inward longitudinally inside the interior. Further, on the upper surface portion of the switch case 1 is provided an opening 1D, and on the bottom thereof is built-in a base IE, In the base IE is provided a storing concave portion 1F of the spring 3 and a deriving Hall 1G of the output lead wire 5.

[0027] The movable member 2, as shown in FIGS. 2, 3, has a concave portion 2a to fix the magnet 6 and an upper storing chamber 2b of the spring 3. The magnet 6 is fixed to the concave portion 2a by an adhesive agent and the like.

[0028] The movable member 2, as shown in FIGS. 1 to 4, is stored inside the chamber 1a inside the switch case 1, and the upper portion of the spring 3 stored in the concave portion IF is inserted into the interior of the storing chamber 2b so as to support the movable member 2, and in this state, an upper end portion 2c of the movable member 2 protrudes from an opening 1D of the upper surface portion of the switch case 1. An upper portion of the movable member 2 contacts an upper area of chamber 1a of switch case 1 to retain the movable member 2 in switch case 1.

[0029] Further, in the left and right sides of the movable member 2 are formed protruding portions 2D1 to 2D4, and these protruding portions are fitted to the guide members 1c1, 1c2 of the guide portion 1c with a little clearance.

[0030] The Hall IC 4 is positioned by the positioning members 1b1 to 1b3 of the positioning portion 1b in the chamber 1a inside the switch case 1, and is mounted on the base 1E. The output lead wire 5 from the Hall IC4 is derived to the outside via the deriving Hall 1G.

[0031] Due to the above-described constitution, the movable member 2 in a state of not pressing the upper end portion 2c is supported by a repelling force of the spring 3, and the upper end portion 2c protrudes from the opening 1D. At this time, a magnetic neutral point 6a of the magnet 6 is slightly above an operating point 4a of the Hall IC 4. An output signal obtained in this state from the output lead wire 5 of the Hall IC 4 is in an OFF state.

[0032] Next, when the upper end portion 2c is pressed, the movable member 2 moves downward, and the neutral point 6a of the magnet 6 passes through the operating point 4a of the Hall IC 4, and at that point in time, the output signal is turned ON. By pressing or non-pressing the upper end portion 2c in this way, the output signal of the Hall IC 4 can be turned On or OFF (or OFF or ON).

[0033] Referring to Fig. 9, the switch of the invention can be activated by an operating force of only one (1) gram. The movable member 2 is in the upper position where the upper end portion 2c is not pushed. In this configuration, the operating point 4a of the Hall IC 4 is just under the N-pole side isomagnetic field plane $+V_{20}$ of 20 Gauss, while the magnetic neutral point 6a of the magnet 6 is located above the plane $+V_{20}$. Isomagnetic field plane V_0 in which the magnetic field is zero (0) is orthogonal against the surface of the magnet 6 at the neutral point 6a

[0034] The upper end portion 2c is then pushed, and the magnet 6 moves downward in the direction shown by an arrow A. When the S-pole isomagnetic field plane $-V_{20}$ of 20 Gauss passes through the operating point 4a, the Hall IC 4 outputs an ON signal because its threshold from OFF state to ON state is set to magnetic field corresponding to the plane $-V_{20}$. The magnetic field is higher than 20 Gauss while the upper end portion 2c is pushed, so that the ON signal is sustained.

[0035] When the upper end portion 2c goes back to the original position, the magnetic neutral point 6a moves upward. At the moment the S-pole isomagnetic field plane $-V_{17}$ of 17 Gauss passes through the operating point 4a, the ON state of the Hall IC 4 changes to OFF state because its threshold from ON state to OFF state is set to the magnetic field corresponding to the plane $-V_{17}$. Setting two kinds of thresholds like $-V_{20}$ and $-V_{17}$ prohibits self-oscillation of the Hall IC.

[0036] As described above, in order to activate the switch of the invention, it is only necessary to apply a magnetic field corresponding to the threshold of the Hall IC 4 to the operating point 4a, which needs little operating force, only one (1) g, because the Hall IC is not attracted by the magnet. In contrast, in the case of a conventional switch employing the combination of a reed switch and a magnet, the reed switch is attracted by the magnet so that

it can not be switched by such a small force. Furthermore, in the switch of the invention, the distance necessary for switching on is only several μm, but in the conventional switch employing the combination of the reed switch and the magnet, such a distance is several mm.

[0037] FIGS. 10 to 12 show one example of a mounting bracket to mount the switch of the invention on a desired member as occasion demands. In the drawings, reference numeral 10 denotes a mounting bracket, reference numeral 10a, an engaging portion, reference numeral 10b, a case mounting opening portion, and reference numeral 10c, a mounting portion.

[0038] As shown in FIGS. 2 and 3, the engaging portion 10a of the mounting bracket 10 is engaged with an engaging Hall 1H of the switch case 1, and the opening portion 10b is fitted to the opening 1D of the switch case 1. Mounting Halls 10c1, 10c2 of the mounting portion 10c are used for screw clamping to the desired member.

[0039] FIGS. 13 to 15 show a lid member 11 to be fitted to the bottom of the switch case 1 as occasion demands and to seal the bottom of the switch. In the drawings, reference numeral 11a denotes a take out Hall of the output lead wire 5 and reference numeral 11b denotes a Hall to inject a filling agent such as silicon resin and the like. The lid member 11 is fitted to the bottom of the switch case 1, and after taking out the output lead wire 5 from the take out Hall 11a, silicon resin is injected into the take out Hall from the Hall 11b which seals the Hall.

[0040] As described above, according to the invention, an ultra compact magnetic induction switch can be constituted operable with a small operating force of about one gram level. Further, since members other than the Hall IC, the magnet, and the spring can be formed by synthetic resin, a sharp reduction in costs can be achieved. Further, as an output of the Hall IC, a switch output of OFF-ON or ON-OFF can be easily obtained.